

MONTANA DEPARTMENT OF FISH AND GAME
FISHERIES DIVISION

JOB PROGRESS REPORT

State Montana
Project No. F-33-R-8 Title Age and growth analysis of fishes of
Job No. I-b Flathead Lake - Kokanee
Period Covered July 1, 1973 through June 30, 1974

ABSTRACT

Age and growth characteristics were established by analyzing measurements from 1,047 scale samples collected from Flathead Lake during the 1973 growing season. An insignificant degree of overlap in the size range between age classes allowed separation on size alone. Growth comparisons were made between the 1972 and 1973 growing seasons. Three year old kokanee dominated the mature fish during the 1973 season. Variability of the dominant age group within the spawning populations was noted. Size and age of maturity of kokanee reared in hatchery aquarium were measured.

BACKGROUND

Flathead Lake, in northwest Montana, is the state's largest and one of the most important fishing lakes. This large lake contains 20 fish species. Knowledge of their habits and the relationship between species is essential in managing the fisheries resource. Determination of the age of fish is important because it is basic to assessing intra- and inter-specific relationships. Age determination, in conjunction with length and weight, relates to productivity.

Age and growth studies have been limited on this lake because of its large size and great depth and the difficulty of obtaining adequate scale samples. The recent fish sampling program, 1967-1970, and the development of a new experimental purse seine have provided adequate numbers and size selection of fish and, in turn, scale samples for age and growth analysis of several species of fish, particularly the kokanee.

OBJECTIVES

The objective of this job is to read, interpret, analyze and report on the eight-year accumulation of scale samples collected during the systematic and seasonal sampling of fish in Flathead Lake. Additional and other specific sampling will provide growth information for present conditions on the

lake. The initial work will include the analysis of the age and growth of the major game fish species: kokanee, lake whitefish, cutthroat trout, Dolly Varden, lake trout and pygmy whitefish.

PROCEDURES

Scale samples for the age and growth analysis were obtained from fish collected during the 1973 growing season, May 29 through August 20, 1973. A total of 710 samples were collected from fish obtained in the purse seine, while 333 samples were obtained through sportsmen creel checks.

The scale sample was extracted from the fish in an area above the lateral line and just posterior to the dorsal fins. The scales were extracted from the fourth row of scales above the lateral line and stored in individual envelopes for each fish. Fish measurements were made to the nearest millimeter in total length (T.L.) and nearest gram in weight. Plastic impressions were made from the scales in a hydraulic press with head plates regulated at 2000 F. Impressions of the scales were enlarged 67 diameters with the aid of a Bausch and Lomb microbeam projector. Measurements of the anterior radii were made along a ventral 20° radial line, (Mosher, 1969) and rounded to the nearest millimeter. These measurements were the same as those used by Hanzel, 1974, in his interpretations of the 1972 kokanee growth analysis. Calculated lengths at annulus formation were derived from the body-scale relationship computed from the combined totals of 1972 and 1973 body-scale measurements.

FINDINGS

Kokanee Growth

A total of 1,047 kokanee scale samples collected from Flathead Lake during the 1973 growing season, May 29 through August 20, 1973, were analyzed for age and growth characteristics. A length frequency histogram for the age groups present was prepared (Figure 1). The percentages of each age group were as follows: Age I+ - 2.1; Age II+ - 36.8; Age III+ - 50.5; Age IV+ - 10.6. No fish representing age groups 0+ and V+ were taken during the collections.

The average total length of fish at time of capture, for ages I+ through IV+ respectively, were as follows: 134mm (5.3 inches); 215mm (8.5 inches); 251mm (9.9 inches); 295mm (11.6 inches). A comparison of the average lengths from 1972 to 1973 for each age group was as follows: growth during the first year was found to be the same during both years; growth of the second year increased 11mm (0.4 inches) during 1973; and growth during the third and fourth years decreased 16mm (0.6 inches) and 14mm (0.5 inches), respectively in 1973.

Growth rate of the 1973 kokanee was determined after establishing a body-length-scale radius relationship of the combined body-scale measurements obtained during 1972 and 1973 seasons. Collectively, the 430 pair measurements of 1972 and the 1,047 pair measurements obtained in 1973 would result in attaining a more accurate body-scale relationship. The use of the combined

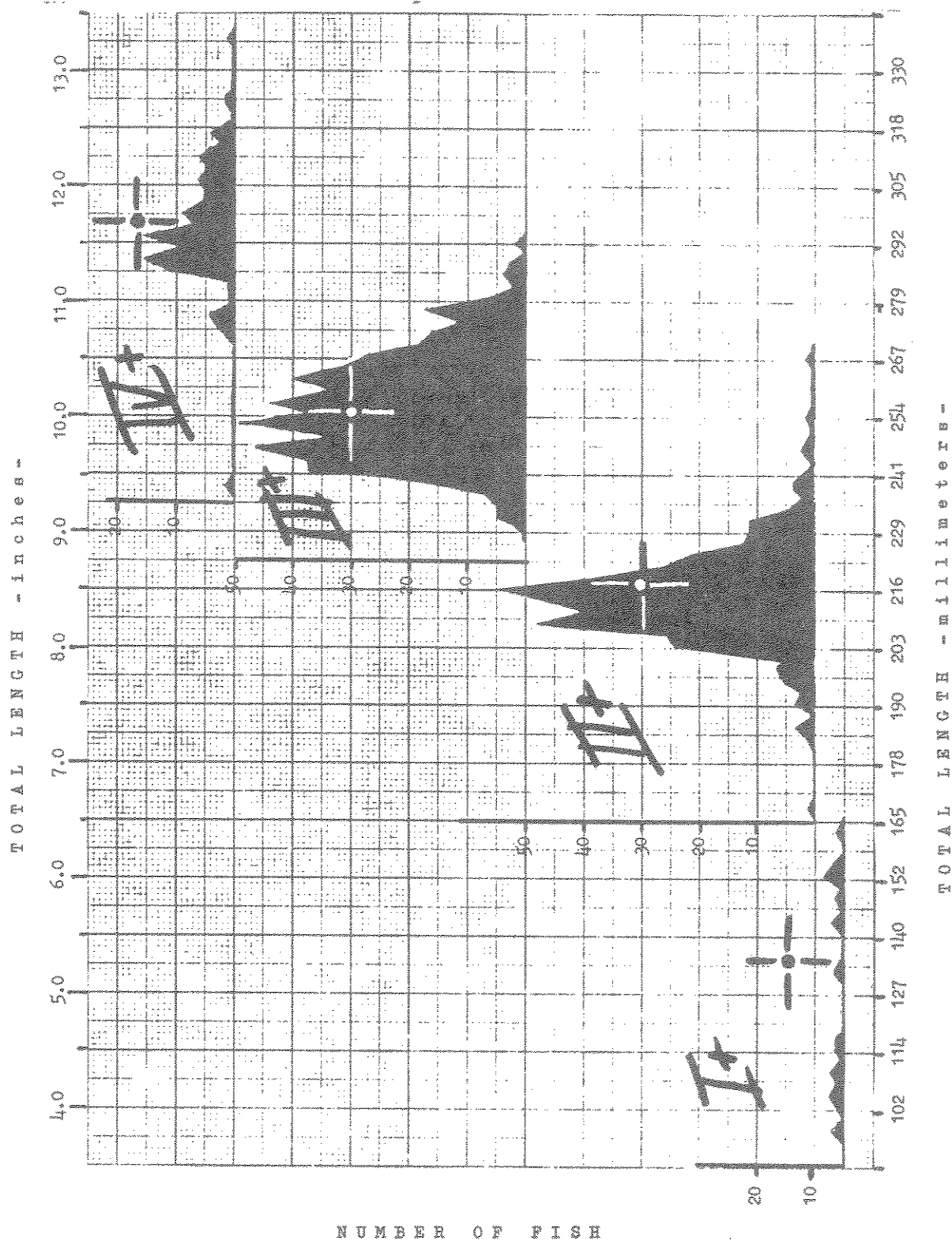


Figure 1. Length frequency histograms showing the age groups represented by 1,047 kokanee with the average length point indicated, for each age group taken in Flathead Lake, May 29 through August 20, 1973

data was advised by statistical programmer Mr. Burwell Gooch, Department of Administration, Helena, Montana.

The combined data yielded a value of the co-efficient of variation "r" of 0.9880, which suggests an even stronger degree of linearity than established during the 1972 analysis.

The regression equation calculated from the combined 1972-73 measurements was: Body Length (T.L.) = 2.3 Anterior Scale Radius + 53.0.

Mean body lengths for each scale radius were plotted as shown in Figure 2, with the solid line representing the calculated equation. A comparison of the 1972 and 1972-73 regression equations indicated only a slight change in the slope of the regression line. Such a slight difference in lines did not change the calculated lengths more than ± 2 mm when comparing scale radius measurements at the extreme limits of fish lengths found in Flathead Lake. The data from either year, with such similarity, would be comparable without further correction.

Growth increments were calculated by age group, sex and state of maturity (Table 1). State of maturity was established by examining gonadal tissues and determining whether the fish would or would not spawn during the 1973 season. The presentation of the data in these categories allows comparison of growth for different periods for any specific age and also provides data on fish the same age that would mature at different rates.

The growth patterns of the age groups of mature and non-maturing fish, for ages 2 years and older, were the same during 1973 as was found during 1972 analysis. i.e., non-maturing fish of the same age were smaller than those that would spawn that particular season.

The average increments of growth, sexes and stages of maturity combined, for ages one through four were: 111, 82, 50, and 33mm, respectively. Forty percent of a typical salmon growth would occur during the first year of life, 30 percent the second, 18 percent the third and 12 percent the fourth year of life.

The degree of overlap in total length between adjacent age groups in 1973 (Figure 1) was more significant than experienced during the 1972 growing season. The increased growth of the two year old salmon during 1973 coupled to the decreased growth of both the three and four year old salmon brought the size ranges of the age groups much closer than the previous year; however, age groups could still be distinguished by size alone.

Age at Maturity

Age at maturity was determined for 296 kokanee (Table 2). Three year old salmon comprised the dominant age group of the mature fish, 72.6 percent. Four year old salmon made up the bulk of the remainder with 26.0 percent.

The change of dominant age classes found in the spawning populations during the last three spawning seasons illustrates the variability in the age composition of the spawning fish. As stated previously, the 1973 population was dominated by age class three, 72.6 percent. Age class four dominated the 1972 spawning population with 71.0 percent of the spawners; while in 1971,

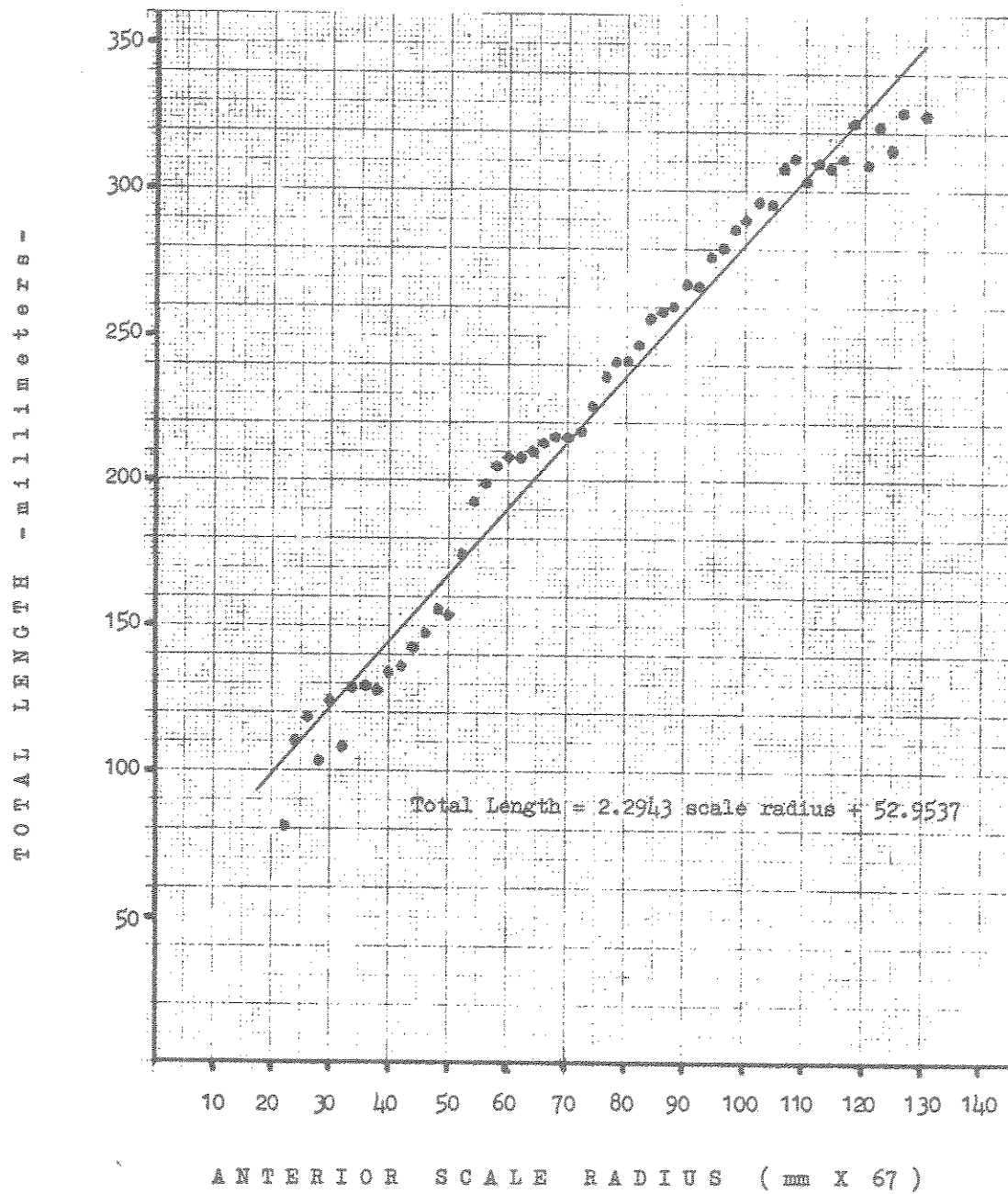


Figure 2. Body length-scale radius relation of kokanee from Flathead Lake. Solid line is the calculated equation; dots represent mean body lengths for given scale radii, 1972 and 1973.

Table 1. Average calculated total length (millimeters) and average length at capture of kokanee that will spawn (+) and will not spawn (-) in 1973 Flathead Lake, May 29 - August 20, 1973

| Group | Sex | No. of Fish | Average length at capture | | Calculated length at annulus formation | | | |
|---------|-----|-------------|---|----------|--|-----|-----|-----|
| | | | -mm- | -inches- | 1 | 2 | 3 | 4 |
| I+ | ♂- | 6 | 133 | 5.2 | 103 | - | - | - |
| | ♀- | 3 | 138 | 5.4 | 109 | - | - | - |
| | Unk | 13 | 134 | 5.3 | 103 | - | - | - |
| II+ | ♂- | 53 | 219 | 8.6 | 114 | 199 | - | - |
| | ♂+ | 2 | 227 | 8.9 | 116 | 214 | - | - |
| | ♀- | 54 | 220 | 8.6 | 113 | 202 | - | - |
| | ♀+ | 2 | 232 | 9.1 | 112 | 211 | - | - |
| | Unk | 274 | 213 | 8.4 | 110 | 191 | - | - |
| III+ | ♂- | 51 | 252 | 9.9 | 109 | 192 | 240 | - |
| | ♂+ | 115 | 266 | 10.5 | 114 | 198 | 247 | - |
| | ♀- | 34 | 246 | 9.7 | 107 | 186 | 235 | - |
| | ♀+ | 100 | 259 | 10.2 | 115 | 198 | 245 | - |
| | Unk | 229 | 242 | 9.5 | 108 | 189 | 235 | - |
| IV+ | ♂- | 4 | 292 | 11.5 | 107 | 196 | 249 | 278 |
| | ♂+ | 54 | 299 | 11.8 | 110 | 199 | 261 | 281 |
| | ♀- | 3 | 285 | 11.2 | 110 | 190 | 247 | 260 |
| | ♀+ | 23 | 289 | 11.4 | 105 | 190 | 252 | 273 |
| | Unk | 27 | 291 | 11.5 | 109 | 188 | 253 | 270 |
| Average | ♂ | | | | 103 | 97 | 45 | 36 |
| Incre- | ♀ | | | | 109 | 93 | 40 | 30 |
| ment | Unk | | | | 103 | 88 | 44 | 35 |
| <hr/> | | | | | | | | |
| Average | ♂ | 285 | | | 112 | 198 | 249 | 281 |
| Length | ♀ | 218 | | | 112 | 197 | 244 | 271 |
| | Unk | 554 | | | 109 | 109 | 237 | 270 |
| <hr/> | | | | | | | | |
| Total | | 1,047 | Weighed average of body length at annulus formation | | 111 | 193 | 243 | 276 |

Table 2. The percentage of the total number of male and female kokanee in each age class considered mature and the percentage of the mature fish in individual age classes, Flathead Lake, May - August, 1973

| Age Class | Males | | Females | | Combined | |
|-----------|----------|-------------------|----------|-------------------|----------|-------------------|
| | % Mature | % of total Mature | % Mature | % of total Mature | % Mature | % of total Mature |
| II+ | 3.6 | 1.2 | 3.6 | 1.6 | 3.6 | 1.4 |
| III+ | 68.3 | 67.3 | 75.2 | 80.0 | 71.7 | 72.6 |
| IV+ | 93.3 | <u>31.5</u> | 88.5 | <u>18.4</u> | 91.7 | <u>26.0</u> |
| | | 100.0 | | 100.0 | | 100.0 |

ages three and four shared dominance with 51.9 and 45.9 percent of the spawners, respectively. Age groups two and five are found in the spawning populations but rarely represent more than 10.0 percent of the mature fish, collectively.

The sex ratio of males to females during the 1973 season was slightly more with 1.0 male to 0.7 females; this ratio is compared to 0.6 and 0.5 females per male during 1972 and 1971 seasons, respectively.

Hatchery Reared Kokanee

A test lot of approximately 200 kokanee was raised to maturity in a glass front aquarium inside the hatchery buildings at the Flathead Lake Salmon Hatchery near Somers, Montana. The rearing tank measured 4 feet wide, 18 feet long and 3 feet deep and received water from the hatchery spring supply whose seasonal temperature varies between 38° to 58° F.

The fish were randomly selected from a mixed lot of production eggs obtained from Whitefish Lake, Flathead Lake and McDonald Creek spawning areas. The eggs were taken during November of 1970 and hatched April 1, 1971. The fish remained in the production lot until June 17, 1971 when they were separated and placed in the aquarium. They were fed dry commercial pelleted food.

In June, 1971, the fish ranged in size from 35 to 40mm (1.4 to 1.6 inches) T.L. when placed in the aquarium. The lot was not checked again until July 13, 1973, when 80 specimens were checked for length and sexual maturity. The fish, now two years old, ranged in size from 209 to 328mm (8.2 to 12.9 inches). The group averaged 272mm (10.7 inches) with the size of males and females similar. Determination of maturity was done by checking the gonad development; 90.9 percent of the males and 70.2 percent of the females were considered mature and would spawn that fall.

On December 13, 1973, 52 kokanee were taken from the aquarium and checked for length and maturity. The fish, now II+ (two years old), had lived through

three growing seasons, ranged in size from 294 to 405mm (11.6 to 16.0 inches) and reached a maximum weight of 867 grams (1.90 pounds). The fish now showing sexual dimorphism averaged 343mm (13.5 inches) for males and 317mm (12.5 inches) for females. All fish taken on this data were sexually mature and would have spawned.

Combining the kokanee checked in July with those checked in December, the percentage of mature salmon was 95.3 for males and 82.1 for females. These fish would have spawned during the 1973 spawning season at Age II+ annuli.

Nine kokanee were left in the aquarium and showed no signs of dimorphism or maturing that season. These fish would spawn during the 1974 season at age three.

The size of the two year old salmon reared in the aquarium on dry pelleted food was considerably larger than the two year old salmon from the lake. The tank-reared salmon during July ranged from 209 to 324mm (8.2 to 12.7 inches) while lake-reared fish ranged from 190 to 267mm (7.5 to 10.5 inches).

RECOMMENDATIONS

It is recommended that the assessments of the growth characteristics from kokanee scale collections be continued a third and final year. The additional time is needed to measure annual growth variations and to establish area differences and allows comparisons of growth patterns of fish from birth to death. This information is basic to the final assessment of mortality rates, abundance, distribution and habitat requirements.

LITERATURE CITED

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Waters referred to: Flathead Lake 7-6400-03